Indian Journal of Chemistry
Vol. 48B, July 2009, pp. 1041-1044

Note

New coumarin diol from the plant, *Chloroxylon swietenia* DC

G Venkateswara Rao*, K Sambasiva Rao, T Annamalai & T Mukhopadhyay

CavinKare Research Centre, 12, Poonamalle Road, Ekkattuthangal, Chennai 600 032, India

Email: rao.gv@cavinkare.com

Received 3 September 2008; accepted (revised) 6 April 2009

A new coumarin diol has been isolated along with three known coumarin compounds, 6,8-diprenylumbelliferone, bergapten and isopimpinellin from the chloroform fraction of the leaves of the plant, *Chloroxylon swietenia* DC**.** The structure of new compound has been established as 6-(2′,3′-dihydroxy-3-methylbutyl)-8-prenylumbelliferone based on the spectral (UV, IR, ^{1}H, ^{13}C and 2D NMR and mass) data.

Keywords: *Chloroxylon swietenia* DC, coumarins, 6-(2′3′-dihydroxy-3-methyl butyl)-8-prenylumbelliferone.

Chloroxylon swietenia DC (Rutaceae) is a medicinally important plant has long been used in indigenous medicine in the treatment of various diseases. The decoction of the leaves was reported as a lotion for ulcer and for healing abrasions of the skin and the smoke from burning leaves is being used to drive away ticks from stables[1]. The decoction of the bark is astringent and used in contusions and for painful joints[1]. The leaves are also prescribed in rheumatism[1,2]. The plant contains an alkaloid which produce irritation and causes dermatitis when applied to the skin[2]. Previous reports on this plant occurring in different regions of India yielded terpenoids like, geijerene, pregeijerene and germacrene D from the volatile oil of leaf and stem[3]; phenolics like, xylotenin, isopimpinellin, bergapten and hellettin from leaves[4]; coumarins like, swietenocoumarins A-F, 8-prenylnodakenetin, demethylluvangetin, xyletenn, rutamarin, chalepin and suberosin from heart wood[5]; alkaloids like, skimmianine and γ–fagarine[6] from heart wood and switenidin A and B from bark[7]; lignans like, hinokinin, savinin, collinucin and syringaresinol from heart wood[7]. In addition to the above, three sugar compounds, 4-O-methylglucouronic acid, glucouronic acid and arabinose from the gum exudates[8] and glycerides of stearic, palmitic, oleic and linoleic acids[9]. The essential oil obtained from the leaves of *C. swietenia* showed insecticide, antifeedant and oviposition deterrent effects on tobacco cutowarm and *Spodoptera litura*[10]. The essential oil obtained from the flowers, exhibited anti-fungal activity against *Aspergillus terreus*, *A. niger, A. oryza, Fursarum solani* and *Curvularia prasadi*[11a]. The essential oil from the leaves was found to be comparable with standard bactericidal compound and anti-fungal activity is inferior to the standard[11b].

In continuation of our interest on the isolation of bioactive compounds for cosmetics use[12,13], we have undertaken chemical examination of the leaves of *Chloroxylon swietenia*. The present paper describes the isolation of a new coumarin diol **1** along with 6,8-diprenylumbelliferone **2,** bergapten **3** and isopimpinellin **4** (**Figure 1**). The new compound **1** has been characterized as 6-(2′,3′-dihydroxy-3-methylbutyl)-8-prenylumbelliferone through its spectroscopic data

Results and Discussion

Compound **1** was obtained as colourless crystals, m.p. 120-22°C. It was readily recognized as coumarin derivative from its preliminary spectral data. Its molecular formula was fixed as $C_{19}H_{30}O_4$ by EI mass, M^+ 322. Its IR spectrum showed the presence of hydroxyl (3542 cm^{-1}), carbonyl (1707 cm^{-1}) and aromatic (1690 and 1620 cm^{-1}) groups and its UV spectrum showed characteristic absorbance for coumarin moiety at 335, 263, 253 and 242 nm. The proton NMR spectrum (**Table I**) clearly showed two doublet signals at δ 6.19 (J = 9.4 Hz) and δ 7.47 (J = 9.4 Hz) are characteristic of 3-H and 4-H of coumarin moiety[14]. The spectrum showed only one aromatic proton at δ 7.09 as singlet and the remaining are substituted. It further showed two double bonded methyls at δ 1.82 (s) and 1.68 (s), an olefinic proton at δ 5.29 (J = 7.4 Hz) as triplet and benzylic and allylic methylene protons at δ 3.49 (m) are indicating the presence of prenyl group in the molecule. In addition to the above peaks, the spectrum also showed two tertiary methyls at δ 1.23 (s) and 1.36 (s), one secondary alcoholic proton at δ 4.73 (J = 8.8 Hz) as triplet, two benzylic protons at δ3.21 (m) indicating that an additional C-5 unit present in the molecule.

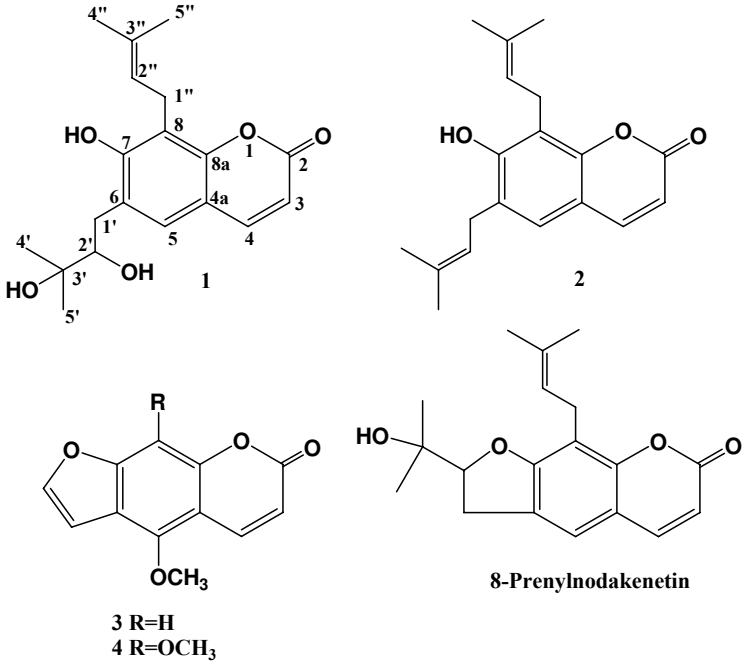

Figure 1 — Compounds **1**, **2**, **3**, **4** and 8-Prenylnodakenetin

Table I — ^{1}H and ^{13}C NMR spectral data of compound **1** in $CDCl_3$ (400 MHz for ^{1}H and 100 MHz for ^{13}C NMR)

Carbon No.	δ_H	δ_C
2		161.6
3	6.19 d (9.4)	112.9
4	7.57 d (9.4)	144.1
4a	-	111.9
5	7.08 s	120.8
6	-	124.1
7	-	161.2
8	-	111.5
8a	-	153.1
1′	3.21 m	25.7
2′	4.73 t (8.8)	71.9
3′	-	90.5
4′	1.23 s	22.7
5′	1.36 s	24.4
1″	3.49 m	29.8
2″	5.29 t (7.4)	120.6
3″	-	132.8
4″	1.82 s	17.9
5″	1.68 s	25.8

J values (Hz) are given in parentheses

Its ^{13}C NMR spectrum of compound **1** (**Table I**) showed 19 carbon signals indicate that the molecule should be substituted diprenyl coumarin derivative. Out of 19 carbon signals, nine signals are corresponding to basic coumarin skeleton (δ 111.5, 111.9, 112.9, 120.8, 124.1, 144.1, 153.1, 161.2 and 161.6). The spectrum also showed two olefinic carbon signals at δ 120.6 and 132.8, one methylenic carbon signal at δ 22.5 and two methyl signals at δ 17.9 and 25.8 were corresponding to prenyl group of the molecule. The remaining five signals (δ 24.2, 25.7, 29.8, 71.9, 90.5) were accounted for substituted prenyl group probably, 2,3-dihydroxy-3-methylbutyl. According to the biogenetic pathway the two prenyl groups will be at C-6 and C-8 positions. By comparing the literature[15], the proton and carbon data of coumarin derivative **1** is found exactly matching with the reported data of 6,8-diprenylumbelliferone **2** except data of 6-prenyl position. So, the basic skeleton of the compound **1** is similar to that of compound **2**. Disappearance of two olefinic carbons and appearance of two oxygenated carbons (δ 71.9 and 90.5) and secondary alcoholic carbon signal (δ 71.9) suggested that compound **1** might be oxidized version of compound **2**. To confirm the position of second prenyl group and hydroxyl group, recorded its NOESY and HOMO COSY spectra and not obtained clear conclusion. Subsequently recorded its HMBC spectrum and observed the following spatial connectivities: C_1' H (δ3.21) with C_2' (71.9), C_3' (90.5), C_6 (124.1), C_7 (161.2); C_2'-H (δ 4.73) with C_1' (25.7) and

C_1''-H (δ3.49) with C_7(161.2), C_8(111.5), C_{8a}(153.1), C_2'' (120.6), C_3''(132.8). Based on the above data it has been established that the structure of the coumarin diol molecule from *C. swietenia* is as depicted in **1**. The new coumarin with dihydroxy functionality which presumably is the hydrolyzed version of known compound, 8-prenylnodakenetin reported from the same plant collected in India[5].

The structures of known compounds, **2** (Ref. 15), **3** (Ref. 16) and **4** (Ref. 4) were established by compareson of their physical and spectral data with literature values.

Experimental Section

Melting points reported are uncorrected. The 400 MHz NMR spectra were recorded on a Brucker AMX 400 in $CDCl_3$ with TMS as an internal standard. The ^{13}C NMR spectra were recorded at 100 MHz; IR spectra were recorded on a Shimadzu IR prestige 21; UV spectra were recorded on a Shimadzu UV spectrophotometer, elemental analysis was performed on a Elementar Vario EL III and EI mass spectra were recorded on a Jeol SX 102/DA 600 mass spectrometer. TLC was performed on pre-coated silica gel 60 F_{254} plates (Merck) and the spots were visualized by exposure to iodine vapour or spraying with 5% sulphuric acid in methanol followed by heating the plate at 110°C for 5 min.

Plant material

Chloroxylon swietenia DC leaves were collected from Krishnagiri (Tamil Nadu, India) in 2006 and identified by Dr. P. Santhan, Botanist, Durva Herbal Centre, Chennai. A voucher specimen was deposited in CavinKare Research Centre, Chennai, India.

Extraction and Isolation

Air dried and coarsely powdered leaves (235 g) of *C. swietenia* were extracted with methanol (2 L) by using soxhlet apparatus. The crude methanolic extract (70 g) was suspended in water: methanol (8:2) and partitioned successively with hexane, chloroform, ethyl acetate and saturated *n*-butanol solvent to get fractions which upon concentrations gave fractions of 14.9 g, 6.87 g, 0.4 g and 3.2 g respectively. After TLC analysis, the dark green residue from chloroform fraction (6.87 g) was purified over a column of silica gel (100-200 mesh) using *n*-hexane:EtOAc (3:1 and 1:1) eluents. The homogeneous fractions were combined based on TLC and divided into three major fractions A1 (1.35 g), A2 (2.25 g) and A3 (2.60 g). Fraction A1 (1.25 g) was further purified by silica gel column using a solvent mixture hexane:chloroform (6:4) yielded two compounds which were re-crystallized with hexane to get pure compounds **3** (36 mg) and **4** (65 mg). Fraction A2 (2.25 g) was applied to a silica gel column using a solvent system hexane: ethyl acetate (1:1) to get major fraction. This fraction was repeatedly purified over silica gel column. It was finally purified by impregnated silica gel (10% $AgNO_3$) column and followed by re-crystallization with chloroform to get pure compound as colourless crystals, **1** (80 mg). Fraction A3 (2.60 g) was further purified by two repeated silica gel columns using hexane:ethyl acetate (1:1) and finally purified by impregnated silica gel (5% $AgNO_3$) column to get compound which was re-crystallized with chloroform: hexane (1:1) to get pure colourless amorphous compound **2** (120 mg).

Compound 1: Colourless crystals (hexane: chloroform), m.p. 120-22ºC; Anal. Calcd. for $C_{19}H_{30}O_4$: C, 70.80; H, 9.31. Found: C, 70.98; H, 9.53. UV(MeOH): 335, 263, 253 nm; IR (KBr): 3542 (hydroxyl), 2980, 2922, 1707 (α, β-unsaturated lactone), 1690 and 1620 (aromatic), 1579, 1442, 1282 and 1134 cm^{-1}; ^1H NMR (400MHz, $CDCl_3$) and ^{13}C NMR (100MHz, $CDCl_3$): See **Table I**; EIMS: (*m/z*) 322, 314 (M^+-H_2O, 100), 299 (10), 281(62), 241(45), 227 (27), 213 (62).

Acknowledgements

The authors thank Mr. C. K. Ranaganathan, CMD of CavinKare Pvt. Ltd., Chennai for providing the necessary facilities and constant encouragement and also thank to Dr. Santhan for collection and identification of the plant material. Authors are also thankfull M/s. Suven Life Sciences, Hyderabad for providing ^1H, ^{13}C NMR and 2D NMR (^1H-^1H COSY, NOESY, HMBC) spectral data and M/s. TA Labs, Chennai for providing mass spectral data.

References

1 *The Wealth of India, Raw Materials*, (CSIR, New Delhi), **1992**, 483.
2 Kirthikar K R & Basu B D, *Indian Medicinal Plants*, Vol.1, **1993**, 564.
3 Kiran S R, Bhavani K, Devi P S, Rao B R R & Reddy K J, *Bioresource Tech*, 97, **2006**, 2481.
4 Talapatra S K, Bhattaacharya M, Talapatra B & Das B C, *J Ind Chem Soc*, 45, **1968,** 861.

5 Bhide K S, Mujumdar R B & Rao AV R, *Indian J Chem***,** 15B, **1977**, 440.

6 Vorkov J & Sedmera P, *Phytochem*, 11, **1972**, 2647.

7 Bhide K S, Mujumdhar R B & Rao A V R, *Indian J Chem*, 15B, **1977,** 440.

8 Anderson D M W, Bell P C, Gill M C L, McDougall R J & McNab G A, *Phytochem*, 25, **1986**, 247.

9 Rao M G & Simnsen J L, *Indian Forest Records*, 9, **1922,** 95.

10 Kiran S R, Reddy A S, Devi P S & Reddy K J, *Pest management Sci*, 62**, 2006**, 1116.

11 (a)*The Wealth of India*, First supplement series, *CSIR News*, 1, **2000**, 247; (b) Srivastava M, Saxena A & Baby P, *SOFW Journal*, 124, **1998**, 558.

12 Rao G V, Annamalai T & Mukhopadhyay T, *Indian J Chem*, 47, **2008**, 163.

13 Rao G V, *Indian Drugs*, 46, **2008**, 5.

14 Silva D, Kourosch A T, Luc V P & Norbert D K, *Phytochem*, 51, **1999**, 701.

15 Chihiro I, Masataka I, Motohara J, Naoyuki, S, Harukuni T, Hoyoku N & Hiroshi F, *Planta Medica*, 71, **2005**, 84.

16 Warren S & Baiely B K, *Can J Chem*, 47, **1969**, 2425.